BLM LIBRARY
88032637

SAGE GROUSE HABITAT USE IN THE BROWN'S BENCH AREA OF SOUTH-CENTRAL IDAHO

by

James H. Klott
Bureau of Land Management
Jarbidge Resource Area
Twin Falls, ID

Randall B. Smith
Idaho Department of Fish & Game, Region 4
Jerome, ID

Charlene Vullo
Bureau of Land Management
Jarbidge Resource Area
Twin Falls, ID

QL
84.2
.L352
no.93-4

IDAHO BUREAU OF LAND MANAGEMENT TECHNICAL BULLETIN NO. 93-4 DECEMBER 1993

29644312 ID88032637

BLM LIBRARY
SC-653, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047

QL
84.2
.L352
no.334

SAGE GROUSE HABITAT USE IN THE BROWN'S BENCH AREA OF SOUTH-CENTRAL IDAHO

James H. Klott
Bureau Land Management
Jarbidge Resource Area
Twin Falls, ID

Randall B. Smith
Idaho Department of Fish & Game
Region 4,
Jerome, ID

Charlene Vullo
Bureau Land Management
Jarbidge Resource Area
Twin Falls, ID

December 29, 1993

INTRODUCTION

Sage grouse is the most abundant large upland game bird within the Jarbidge Resource Area. However, very little is known about their seasonal movements and distribution. A sage grouse telemetry study initiated in 1989 (Makela et al. 1993) documented that some sage grouse from the Shoshone Basin area migrated to Brown's Bench about 20 miles to the west to winter. Harvest data indicate that Brown's Bench is one of the top sage grouse harvest areas in south-central Idaho. Idaho Department of Fish and Game records since 1950 show a long term downward population trend for numbers of active leks, numbers of males displaying on leks, and numbers of sage grouse harvested. Sage grouse harvest data show peaks in the harvest in 1950 (2,832), 1970 (739), 1979 (472), and 1990 (221) for Brown's Bench. Since 1985 harvest numbers have remained low even though the season has increased from 9 days to 30 days.

The majority of the sage grouse habitat in the Jarbidge Resource Area is grazed by livestock. Research on sage grouse is providing insight into important seasonal habitats and regionally important sage grouse winter areas so that potential conflicts with grazing seasons of use and utilization can be better identified and assessed. The current research is providing much needed data on: (1) seasonal movements and distribution, (2) vegetational characteristics of seasonal habitats, (3) data on nesting and brood habitat, (4) preliminary data on population dynamics for sage grouse in this part of Idaho.

STUDY AREA

Research was conducted primarily in the Brown's Bench/Monument Springs area of south-central Idaho located about 40 miles southwest of Twin Falls, Idaho (Figure 1). Some effort was made to follow a few sage grouse in the Shoshone Basin area about 20 miles due east of Brown's Bench. The major habitats in the study area include low/black sagebrush/grass, Wyoming sagebrush/grass, mountain sagebrush/grass, and crested wheatgrass seedings. Other habitats present in small amounts are aspen woodland, mountain mahogany woodland, and wet meadow/riparian. Shrub species on Brown's Bench are primarily low sagebrush (Artemisia arbuscula) and black sagebrush (Artemisia nova) in areas with shallow or rocky soils. Wyoming big sagebrush (Artemisia tridentata var. wyomingensis) is found in areas with deep soils at elevations below 6500 feet. Mountain big sagebrush (Artemisia tridentata var. vasevana) is usually found at elevations over 6500 feet. All seedings contained crested wheatgrass (Agropyron cristatum). Grass species are variable depending on the site and elevation. Common grass species are bottlebrush squirrel-tail (Sitanion hystrix), Sandberg bluegrass (Poa sandbergii), bluebunch wheatgrass (Agropyron spicatum) and cheatgrass (Bromus tectorum). Forbs are highly variable and change with site, elevation, and season. Common forbs included balsamroot (Balsamorhiza spp.), pussy-toes (Antennaria spp.), hawksbeard (Crepis spp.), penstemon (Penstemon spp.), phlox (Phlox spp.), fleabane (Erigeron spp.), daisy (Aster spp.), Indian paintbrush (Castilleia spp.) and milkvetch (Astragalus spp.). A complete list of grasses, forbs and shrubs found ate sage grouse nest sites, brood sites, and random plots are contained in the Appendix.

METHODS

Trapping

Sage grouse were captured using a spot light and nets (Giesen et al. 1982, Wakkinen 1990) on or near known leks in March and April. All sage grouse captured were marked with aluminum leg bands and aged (Beck et al. 1975). All females captured were also fitted with poncho-mounted 18 to 20-g radio transmitter (Amstrup 1980). All grouse were released at the point of capture. Females were radio-tracked to determine nest sites and brood

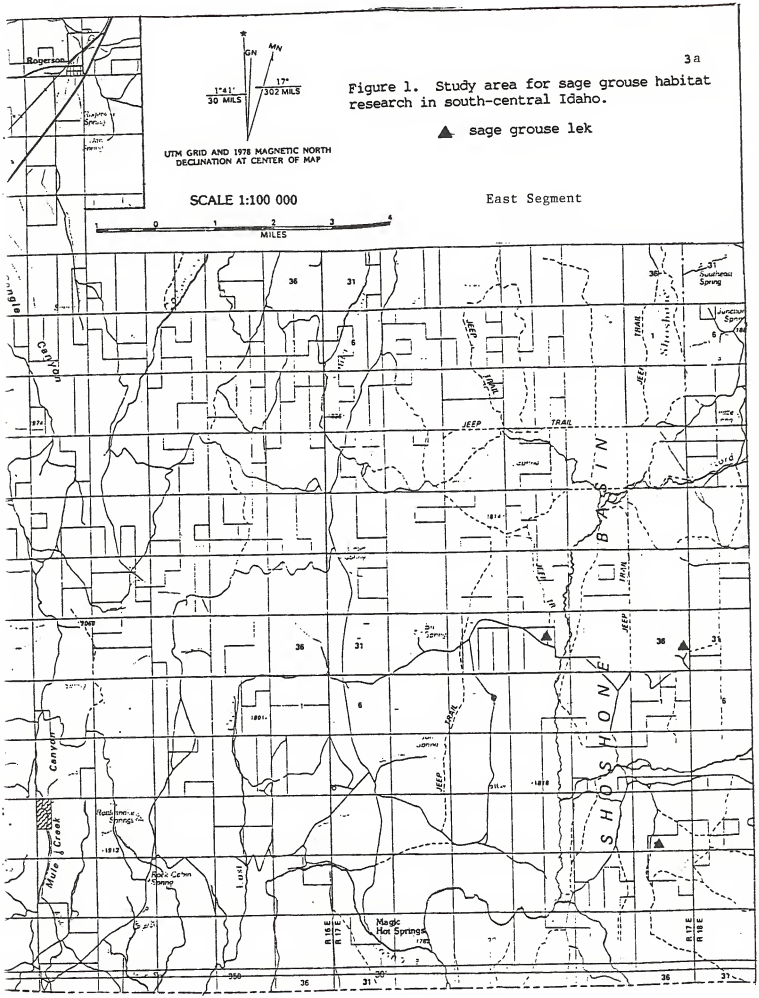
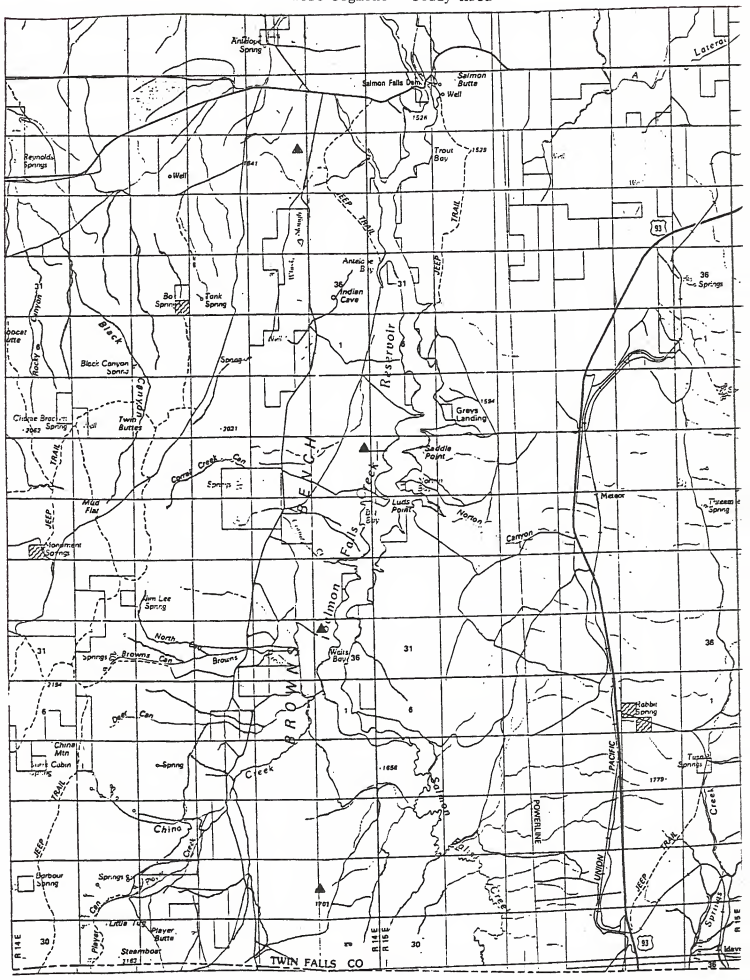


Figure 1. Study area for sage grouse habitat research in south-central Idaho.

▲ sage grouse lek

West Segment - Study Area



locations throughout the summer. Nest and brood locations were plotted on topographic maps. The fate of located nests were determined after the female completed her nesting attempt. Nests were classified as successful if one or more eggs hatched.

Movements

Leks of capture were plotted on topographic maps to determine the distance of movements of sage grouse from the lek of capture to nesting, brood, and summer use areas. The distance from the lek of capture to the nest, brood, or habitat use areas was determined for all radioed sage grouse by measuring the plotted location of the lek of capture to the first location after mid-May. Mid-May was selected to insure that most of the females would be nesting or just hatching broods.

Home Range

Home range size for each radioed individual was determined recording the UTM coordinates from locations plotted on a map. Females with broods were located weekly. Females without broods and males were only located monthly. For females that successfully nested, the home range included the nest site and subsequent brood locations. Males and females that did not successfully nest only had movements evaluated.

Habitat Sampling

A 30 meter transect centered at the nest site or brood location. The direction of the transect was determined by throwing a stick in the air and orienting the transect in the same direction. Along this transect line intercept (Canfield 1941) was used to determine percent shrub cover by species. The intercept was measured to the nearest centimeter. All shrubs intercepted also had the shrub height measured to the nearest centimeter. For herbaceous cover a total of 10 Daubenmire plots (Daubenmire 1959) were read along the transect at distances of 0, 3, 6, 9, 12, 15, 18, 21, 24, and 27-m. Cover classes were listed for each herbaceous species within the 20-cm x 50-cm plot. Grass height was measured to the nearest cm on the grass plant closest to the right hand corner of the Daubenmire frame on the side nearest the 0 end of the transect. Forb height was not measured. Additionally, cover classes were also determined for total grass, total forbs, cryptograms (moss and lichen), litter, rock, and bareground. A total of 10 Robel pole measurements (Robel et al. 1970) were recorded along the transect at 3 meter intervals. Other information collected at each brood location or nest site included: habitat site, the presence or absence of livestock in the pasture, and level of grazing utilization in the area at the time the radioed individual was located. Habitat sites identified included low/black sage brush/grass, Wyoming sagebrush/grass, mountain sagebrush/grass, wet meadow, seeding, mountain shrub, mountain mahogany, and aspen. Utilization classes were none, slight, light, moderate, heavy, and severe.

The same data were collected at locations determined from randomly generated Universal Transverse Mercator (UTM) coordinates for the study area.

Species Diversity

Species diversity was calculated using the jackknife estimate (Heltshe and Forrester 1983, Krebs 1989). The jackknife procedure was selected because it tends to overestimate the number of species in a community, which is less than the negative bias of using only the observed number of species (Krebs 1989). The Shannon-Weaver function (Hair 1980) was not selected because it omits uncommon species, therefore, increasing the negative bias of using observed species.

Statistical Analyses

Variables with normal distributions were to be analyzed using parametric test whereas variables with non-normal distributions were to be analyzed using non-parametric methods. Originally, t-tests (parametric) or Mann Whitney U (non-parametric) were to be used for comparisons for data between random plots and brood use plot (Ott 1984, Zar 1984). The same techniques were used to test for differences at plots where livestock were present or absent. Analysis of variance or multiple analysis of variance (parametric) or Kruskal-Wallis tests (non-parametric) tests were used for comparisons between habitat types and comparisons between grazing utilization levels (Ott 1984, Zar 1984). Small sample sizes and relatively large variances prohibited the valid use of these statistical techniques. Only descriptive statistics (means) are presented in the results for habitat data.

RESULTS AND DISCUSSION

Trapping

Sixty four males and 14 females were captured on Brown's Bench at four leks during the spring of 1993. In Shoshone Basin 28 male and 1 female sage grouse were trapped. Table 1 lists by lek of capture the numbers of sage grouse caught. On Brown's Bench 5 of the 14 females were yearlings, whereas, 15 of the 92 males were yearlings. In Shoshone Basin 6 of 28 males were yearlings.

Table 1. Sex and age class of sage grouse captured in 1993. Data is presented by lek of capture.

	Males		Females		
Lek Name	Adults	Yearling	Adults	Yearlings	Total
Browns Bench					
Browns Bench Trough	22	0	4	1	27
Saddle Point West	10	4	3	2	19
Walts Bay North	7	0	1	0	8
Two Sections	16	5	1	2	24
Shoshone Basin					
Gap	4	1	1	0	6
Horse Creek	9	0	0	0	9
Windmill	8	5	0	0	13
Y	1	0	0	0	1

Sixteen radio transmitters were placed on sage grouse caught at Brown's Bench (14 female, 2 male), whereas, 9 transmitters were fitted on sage grouse in Shoshone Basin (1 female, 8 males - Table 2.). Due to road conditions, spot lighting in the Shoshone Basin area was not initiated until April 20, 1993, after the peak of female attendance. Two females trapped and fitted with radios in 1992 were tracked in 1993.

Movements

Females on Brown's Bench moved an average of 2.87 miles from the lek of capture to nesting or brood habitat. The shortest distance moved to nest was about 0.31 miles, whereas, the longest distance moved was 7.69 miles (Table 2). Female 151.440 from Brown's Bench Trough lek was not relocated. However, her signal may have been picked up in early September after brood break up east of Rogerson. If she attempted to nest in the vicinity of the signal, she would have moved at least 11 miles. Only 2 of the radioed females moved to

the east, 1 moved southwest, 11 moved westward. None of the radioed females were documented to have crossed Salmon Falls Reservoir to nest. Generally, movements to the west and south increased elevation and from changed from low sagebrush/grass habitats to Wyoming sagebrush/grass or mountain sagebrush/grass habitats. Females in Shoshone Basin moved an average of 5.1 miles form the lek of capture. All of the females moved to the east.

Table 2. Movements of sage grouse on Brown's Bench and in Shoshone Basin from lek of capture.

Radio Frequency	Sex	Age Class	Lek of Capture	Distance in miles
Brown's Bench				
150.299	F	Y	Saddle Point West	5.6
151.220	F	A	Walts Bay North	1.2
150.966	M	A	Brown's Bench Trough	2.9
151.263	F	A	Saddle Point West	2.5
151.234	F	A	Saddle Point West	6.8
151.280	F	Y	Saddle Point West	0.3
151.185	F	A	Saddle Point west	1.4
151.383	F	A	Brown's Bench Trough	0.9
151.323	F	A	Brown's Bench Trough	0.8
150.625	F	Y	Brown's Bench Trough	1.2
150.825	F	A	Brown's Bench Trough	7.7
151.440	F	A	Brown's Bench Trough	*
151.441	F	A	2 Sections	1.6
151.308	F	Y	2 Sections	1.1
150.545	F	Y	2 Sections	6.4
151.203	M	A	Brown's Bench Trough	0.7
Shoshone Basin				
151.431	F	A	Gap	5.9
151.311	M	A	Horse Creek	+
150.845	M	A	Windmill	+
150.365	M	A	Windmill	1.7
150.285	M	A	Windmill	+
151.525	M	A	Windmill	1.7
151.100	M	Y	Windmill	+
151.143	M	Y	Windmill	1.7
151.252	M	A	Horse Creek	+
151.325	F	A	Horse Creek (92)	4.2

* individual located after brood break up.
\+ data were not available at the time of this report

Male sage grouse tended to associate with other male sage grouse after the breeding season. In Shoshone Basin several radioed male sage grouse were found together with other males. These groups of males were found in Wyoming sagebrush habitats at distances estimated to be 2.7 miles from the lek of capture. One radioed male on Brown's Bench was last observed with several other males in Wyoming sagebrush habitat about 3 miles from the lek of capture.

Reproduction/Mortality

Of the 14 females trapped on Brown's Bench, 2 were depredated, 1 died from other causes, 1 disappeared from the area, 4 nests failed, 2 apparently never attempted to nest, and 4 successfully raised broods. The average brood size in July was 4.75 juveniles per successful female. Incidental observations of six other sage grouse broods showed 4.67 juveniles per successful female. We were unable to document any nesting attempts from females captured in Shoshone Basin. None of the females had broods later in the year. No renesting attempts were observed at either Shoshone Basin or Brown's Bench. Overall 23.5% of the radioed females successfully nested (4 of 17). Predation on eggs was the suspected cause of nest failures. Ravens (*Corvus corax*), black-billed magpies (*Pica pica*), ground squirrels (*Spermophilus* sp.) and badgers (*Taxidea taxus*) known nest predators (Autenrieth 1981) are found in the study area.

One of the radioed males on Brown's Bench was depredated in late April. Avian predation was suspected. The majority of the location data on males in Shoshone Basin was based on aerial telemetry. This data was not available for inclusion in this report, but will be included in the report on winter movements. One male was never relocated, his radio may have failed or he may have moved from the area. Other researchers (Patterson 1952, Hartzler 1974, Beck 1975, Autenrieth 1986) have indicated that golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicenis*), and ferruginous hawks (*Buteo regalis*) are avian predators of sage grouse young and adults.

Home Range

Originally the Home Range program (Ackerman et al. 1990) was to be used, however, small numbers of locations for each individual precluded the valid use of the Home Range program, which specifies 40 locations per individual. Based on planimetering the locations, the average home range size for the hens with broods was 81.1 acres. The largest home range (159.9 acres) was vegetated primarily by low sagebrush. The remaining home ranges were of similar size (Table 3). Distances moved within the home range increased as the young aged.

Table 3. Home ranges sizes for four female sage grouse with broods.

Female #	Home Range (Acres)	Habitat Type(s)
150.625	50.8	Wyoming sagebrush
151.234	47.4	Wyoming sagebrush/mountain sagebrush
151.280	159.9	Low sagebrush/Wyoming sagebrush
151.323	66.1	Low sagebrush/Wyoming sagebrush

Habitat Use

Nesting

Of the habitats present in the study area for nesting, radioed females used Wyoming sagebrush/grass, low sagebrush/grass, mountain sagebrush/grass, and crested wheatgrass seedings (Table 4). Radioed females did not attempt to nest in mountain shrub, mountain mahogany, aspen, or meadow habitats. Due to very small sample sizes, statistical comparisons of data at nest locations to random points were not attempted. As a general trend shrub height, shrub cover, grass height, and Robel pole readings were greater at nest sites than random plots (Table 5). Litter was generally less, however, this may be due to the season of the year when litter was measured (June at nest sites and July-August at random plots). We noted that females that were unsuccessful in

nesting abandoned the nest area. In two instances they were found with other females in Wyoming big sagebrush habitats.

Brood Rearing

Due to small sample sizes and large variances statistical comparisons were not possible. However, a few trends were noted. Compared to random plots, sites used by broods the number of herbaceous species and plant species richness were greater. A complete list of grasses, forbs, and shrubs observed at nest, brood, or random locations is contained in the Appendix. Shrub height at all brood locations averaged about 33 cm regardless of the habitat site being used (Table 6). Additionally, using the cover classes for the Daubenmire frames for evaluating herbaceous cover (grasses and forbs) instead of percent cover may have contributed to obscuring any differences in vegetation by species or category (grass or forbs) that might have been present.

Table 4. Habitats used by radioed sage grouse females for nesting and brood rearing. Number in () represent successful nests.

Habitat	Nesting Attempts	Brood Locations
Low sagebrush	2 (1)	2
Wyoming sagebrush	4 (2)	7
Mountain sagebrush	1 (1)	4*
Seeding	1 (0)	0
Aspen	0	0
Meadow	0	0
Mountain mahogany	0	0
Mountain shrub	0	0

* denotes brood was in ecotone with meadow habitat

Table 5. Values of variables at sage grouse nest sites by habitat.

	Habitat					
	Wyoming Sage		Low Sage		Seeding	
Variable	Rand.	Nest	Rand.	Nest	Rand.	Nest
Grass cover (class)	3	1	2	1	3	4
Grass height (cm)	9.1	14.5	12.9	15.2	33.4	29.9
Forb cover (class)	2	2	1	1	1	3
No. species (#)	11.8	10.0	10.0	5.0	5.5	23.0
Litter (class)	4	4	3	2	4	3
Bare ground (class)	4	3	5	5	5	4
Shrub cover (%)	23.8	31.5	15.1	15.1	3.9	0.0
Shrub height (cm)	43.2	53.8	16.5	23.7	23.0	0.0
Robel pole (dm)	2.3	4.6	0.7	1.3	1.0	1.9

Cover class values:
1 = trace - 1%, 2 = 1.01 - 5.00%, 3 = 5.01 - 25%, 4 = 25.01 - 50%, 5 = 50.1 - 75.0%

We did detect broods switching habitats. However, there was not a clear pattern associated with habitat type shifts. Abundant moisture in the spring and summer of 1993 and resulting lush vegetation may have reduced movements between habitats or elevations as noted by other researchers (Oakleaf 1971, Wakkinen 1990).

Table 6. Habitat variables by each habitat site for brood locations and random points.

	Wyo Sage		Low Sage		Mtn Sage		Mtn Shrub	Seeding
Variable	Brood	Rand.	Brood	Rand.	Brood	Rand.	Rand.	Rand.
Grass height (cm)	13.1	13.6	19.9	12.9	12.2	10.7	22.1	33.5
Grass (class)	3	3	3	2	4	3	4	3
Forb (class)	2	2	3	2	3	2	3	1
No. herb. species	12.6	11.8	11.0	10.0	17.8	10.3	19.5	5.5
Species richness	16.8	14.2	13.7	11.8	23.4	13.0	24.7	6.9
Crypto. (class)	3	2	2	2	1	1	1	2
Litter (class)	3	3	3	3	3	3	4	4
Soil (class)	3	4	3	4	3	3	3	4
Shrub cover (%)	24.3	23.8	16.7	15.1	13.1	19.8	31.9	3.9
Shrub height (cm)	33.3	43.2	32.3	16.5	33.3	33.2	48.6	23.0
Robel pole (dm)	1.9	2.3	2.1	0.8	1.7	1.8	4.1	1.0

Cover Class Values:
1 = trace - 1%, 2 = 1.01 - 5.00%, 3 = 5.01 - 25%, 4 = 25.01 - 50%

Livestock/Sage Grouse Nesting Habitat

Sage grouse nesting occurred where grazing utilization levels were in the slight category and livestock were not present. Although this could represent selection by sage grouse females, it may also be attributed to these areas being grazed in the summer and fall. These results may also be an artifact of small sample sizes. All of the areas used by nesting grouse had been grazed the previous summer. Utilization in these areas varied from light to moderate during 1992.

Livestock/Sage Grouse Brood Habitat

Sage grouse brood rearing occurred where livestock grazing utilization was light or less. No statistical comparisons were possible of habitat variables at different utilizations levels because of small sample sizes. The bulk of the study area where broods were found is grazed from mid-summer through the fall. We detected no movements by sage grouse with broods away from areas with livestock. Utilization levels of some habitats (wet meadows/riparian and aspen) were high, however, most of the other habitats were in the moderate category with the exception of areas around salt licks and adjacent to water troughs.

Areas with livestock present in Wyoming sagebrush and low sagebrush habitats had less grass cover, less grass height, lower numbers of herbaceous species, less litter, and lower Robel pole readings. Forb cover and bare ground were greater in areas where livestock were present (Table 7).

Some of the preliminary data suggest possible relationships between sage grouse brood habitat use and livestock grazing. However, more data are needed to allow valid statistical comparisons to be made. No trends within the

Table 7. Habitat variables for Wyoming big sagebrush, low sagebrush and mountain big sagebrush in areas where livestock were present (+) and absent (-).

Variable	Wyoming Sage		Low Sage		Mountain Sage	
	+	-	+	-	+	-
Grass cover (class)	2	2	2	3	3	4
Grass height (cm)	11.6	14.4	6.1	16.2	11.4	11.2
Forb cover (class)	2	2	2	3	3	3
No. species	11.8	12.1	8.5	10.0	14.0	15.0
Litter (class)	3	4	3	3	3	3
Bare ground (class)	4	3	5	5	3	3
Shrub cover (%)	26.0	24.0	20.9	14.2	21.2	11.9
Shrub height (cm)	36.5	40.0	17.6	20.6	35.2	31.8
Robel pole (dm)	2.2	2.3	0.8	1.1	2.1	1.4

Cover Class Values:
1 = trace - 1%, 2 = 1.01 - 5.00%, 3 = 5.01 - 25%, 4 = 25.01 - 50%, 5 = 50.1 - 75.0%

vegetation variables (grass height, percent bareground, percent forb cover, percent grass cover) were consistently present across all habitat types. A general trend appears to be that because of low utilization rates by livestock during nesting and early in the brood rearing period, mid-summer and fall grazing appear to allow sage grouse broods to have no detectable impact on sage grouse nesting and brood rearing habitat. The overall utilization rate in these allotments is moderate, and indicates that there is adequate residual herbaceous vegetation for nesting cover in the early spring before much regrowth occurs. Winter through early summer grazing or grazing in the heavy to severe utilization levels may have more of an impact on sage grouse nesting or brood rearing habitat. Impacts of both grazing seasons of use and utilization levels on sage grouse habitat need more research.

Literature Cited

Ackerman, B., F. Leban, M. Samuel, and E. Garton. 1990. User's manual for program Home Range (2nd ed.). For. Wildl. Range Exp. Sta. Tech. Rep. 15. Univ. of Idaho, Moscow. 80p.

Amstrup, S.C. 1980. A radio-collar for game birds. J. Wildl. Manage. 44:214-217.

Autenrieth, R.E. 1981. Sage grouse management in Idaho. Idaho Dept. Fish & Game Wildl. Bull. 9, Boise. 238 pp.

Autenrieth, R.E. 1986. Sage grouse pp. 763-779. In R.L. DiSilvestro, (ed.). Audubon Wildlife Report 1986. R.R. Donnelly and Sons, Co., National Audubon Society, New York. 1094 pp.

Beck, T.D.I. 1975. Attributes of a wintering population of sage grouse, North Park Colorado. MS. Thesis, Colorado State Univ., Fort Collins. 49 pp.

Beck, T.D., R.B. Gill, and C.E. Braun. 1975. Sex and age determination of sage grouse from wing characterisitcs. Colo. Div. Wildl. Game Info. Leafl. 49. 4pp.

Canfield, R.H. 1941. Application of the line interception method in sampling range vegetation. J. For. 39:388-394.

Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. Northwest Sci, 33:43-64.

Giesen, K.M., T.J. Schoenberg, and C.E. Braun. 1982. Methods for trapping sage grouse in Colorado. Wildl. Soc. Bull. 10:224-231.

Hair, J.D. 1980. Measurement of Ecological diversity. pp. 269- 275. In S.D. Schemnitz (ed.)., Wildlife Managment Techniques Manual (4th ed.). The Wildlife Soc., Washington, DC. 686pp.

Hartzler, J.E. 1974. Predation and the daily timing of sage grouse leks. Auk 91:532-536.

Heltshe, J. F. and N.E. Forrester. 1983. Estimating species richness using the jackknife procedure. Biometrics 39:1-11.

Krebs, C.J. 1989. Chapter 10 - Species diversity measures. pp. 328-370. In. C. J. Krebs. Ecological Methodology. Harper Collins Publishers, New York. 654pp.

Makela, P., J. Tharp, and Y.E. Hayden. 1993. Shoshone Basin cumulative effects study. U.S.D.I. Bur. Land Manage., Burley District, Burley, Idaho. -- pp.

Oakleaf, R.L. 1971. Relationship of sage grouse to upland meadows in Nevada. M.S. thesis. Univ. Nevada Reno. 73pp.

Ott, L. 1984. An Introduction to Statistical Methods and Data Analysis (2nd ed.). PWS Publishers, Boston. 725pp.

Patterson, R.L. 1952. The Sage grouse in Wyoming. Sage Books, Inc., Denver, Colo. 341 pp.

Robel, R.J., J.N. Briggs, A.D. Dayton, and L.C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. J. Range Manage. 23:295-297.

Wakkinen, W.L. 1990. Nest site characteristics and spring-summer movements of migratory sage grouse in southeastern Idaho. M.S. Thesis, Univ. of Idaho, Moscow. 57pp.

Zar, J.E. 1984. Biostatistical Analysis (2nd ed.). Prentice Hall, Inc., Englewood Cliffs, NJ. 718pp.

Appendix. List of acronyms, scientific names, and common names for plant species at nest, brood, and random sites in the study area.

Acronym	Common Name	Scientific Name
Grasses		
AGCR	Crested wheatgrass	Agropyron cristatum
AGIN	Intermediate wheatgrass	Agropyron intermedium
AGSM	Western wheatgrass	Agropyron smithii
AGSP	Bluebunch wheatgrass	Agropyron spicatum
BRTE	Cheatgrass	Bromus tectorum
BRCA5	Mountain brome	Bromus carinatus
DACA3	California oatgrass	Danthonia californica
ELCI2	Basin wildrye	Elymus cinereus
FEID	Idaho fescue	Festuca idahoensis
FESTU	Fescue (unkown species)	Festuca sp.
MEBU	Bulbous oniongrass	Melica bulbosa
POA	Bluegrass (unknown species)	Poa sp.
POSA12	Sandberg bluegrass	Poa sandbergii
SIHY	Squirrel-tail	Sitanion hystrix
STLE4	Letterman's needlegrass	Stipa lettermanni
STOC2	Western needlegrass	Stipa occidentalis
STTH2	Thurber's needlegrass	Stipa thurberiana
STIPA	Needlegrass (unkn species)	Stipa sp.
UNK	Unknown grass	
Forbs		
ACMI2	Western yarrow	Achillea millefolia
AGGL	Pale false dandelion	Agoseris glauca
AGOSER	False dandelion (unk species)	Agoseris sp.
ALAC4	Tapertip onion	Allium acuminata
ALDE	Desert alyssum	Alyssum desertorum
ALLIUM	Onion (unknown species)	Allium sp.
ALNE	Nevada onion	Allium nevadensis
ALTE	Textile onion	Allium textile
ALYSSUM	Alyssum	Alyssum sp.
ANDI2	Low pussy-toes	Antennaria dimorpha
ANMI	Pussy-toes	Antennaria microphylla
ANRO2	Rose pussy-toes	Antennaria rosea
ARABIS	Rockcress (unknown species)	Arabis sp.
ARCO9	Ballhead starwort	Arenaria congesta
ARFU3	Hillside arnica	Arnica fulgens
ARKI	King starwort	Arenaria kingii
ARNICA	Arnica (unknown species)	Arnica sp.
ARSO2	Twin arnica	Arnica sororia
ASAT	Owyhee morning milkvetch	Astragalus atratus
ASCA9	Milkvetch	Astragalus calycosus
ASER4	Milkvetch	Astragalus ermiticus
ASLE8	Speckle-pod milkvetch	Astragalus lentiginosus
ASPU9	Wooly-pod milkvetch	Astragalus purshii
ASSC3	Crag aster	Aster scopulorum
ASTER	Aster (unknown sp.)	Aster sp.
BAHO	Hooker balsamroot	Balsamorhiza hookeri
CACH7	Desert Indian paintbrush	Castilleja chromosa
CALI4	Wyoming Indian paintbrush	Castilleja linariefolia
CAMI2	Little-pod false-flax	Camelina microcarpa
CHENOP	Goosefoot (unknown species)	Chenopodium sp.
CIRSI	Thistle (unknown species)	Cirsium sp.
COLI2	Narrow-leaf collomia	Collomia linearis
COPA3	Blue-eyed mary	Colinsia parviflora
COTE	Diffuse collomia	Collomia tenella
COUM	Bastard toadflax	Comandra umbellata
CRAC2	Taper-tip hawksbeard	Crepis acuminata

CRCI2	Mat cryptantha	Cryptantha circumsissa
CREPIS	Hawksbeard (unknown species)	Crepis sp.
CRYPTA	Popcorn-flower	Cryptantha sp.
DERI2	Richardson tansymustard	Descurainia richardsonii
DESCU	Tansy-mustard (unkn species)	Descurainia sp.
ERHE2	Buckwheat	Eriogonum hercaleoides
ERIGE	Fleabane (unknown species)	Erigeron sp.
ERMI	Slender buckwheat	Eriogonum microthecum
ERSP3	Few-flower eriastrum	Eriastrum sparsiflorum
ERUM	Sulphur buckwheat	Eriogonum umbellatum
GAYOPH	Gayophytum (unknown species)	Gayophytum sp.
GILE3	Great Basin gilia	Gilia leptomeria
HAAC	Cushion goldenweed	Haplopappus acaulis
LARE	Stickseed	Lappula redowski
LASE	Prickly lettuce	Lactuca sp.
LEPIDI	Pepperweed (unknown species)	Lepidium sp.
LEPU	Spiny phlox	Leptodactylon pungens
LESQU	Bladderpod (unknown species)	Lesquerella sp.
LIANTHUS	Lianthus	Lianthus sp.
LISE	Northern lianthus	Lianthus septentrionalis
LOFO	Fennel-leaf lomatium	Lomatium foeniculaceum
LOMATIUM	Lomatium (unknown species)	Lomatium sp.
LUAR3	Silvery lupine	Lupinus argenteus
LULA3	Spurred lupine	Lupinus laxiflorus
LUPINUS	Lupine (unknown species)	Lupinus sp.
MEOB	Leafy bluebells	Mertensia oblongifolia
MESA	Alfalfa	Medicago sativa
MIGR	Pink microsteris	Microsteris gracilis
MONTIA	Minor's lettuce	Montia sp.
OPPO	Plain's prickly-pear	Opuntia polyacantha
ORCO	Cancer-root	Orobanche corymbosa
PEPR2	Small-flower penstemon	Penstemon procerus
PHAC2	Prickly phlox	Phlox aculeata
PHHO	Hood phlox	Phlox hoodi
PHLO2	Long-leaf phlox	Phlox longifolia
PODO4	Douglas knotweed	Polygonum douglasi
POLYGO	Knotweed (unkn species)	Polygonum sp.
RATE	Bur buttercup	Ranunculus testiculatus
SIAL2	Jim Hill mustard	Sisymbrium altissimum
SIDO	Douglas silene	Silene douglasi
SIOR3	Oregon silene	Silene oregana
SIOR	Oregon checker-mallow	Sidalcea oregana
TAOF	Dandelion	Taraxacum officinale
TRDU	Salsify	Tragopogon dubius
TRGY	Holly-leaf clover	Trifolium gymnocarpum
TRIFOLIUM	Clover (unknown species)	Trifolium sp.
VIAD	Hook violet	Viola adunca
VIOLA	Violet (unknown species)	Viola sp.
UNK	Unknown forb	
ZIVE	Meadow death-camas	Zigadenus venonous
Shrubs		
AMAL2	Saskatoon serviceberry	Amelanchier alnifolia
ARAR8	Low sagebrush	Artemisia arbuscula
ARTRV	Mountain sagebrush	Artemisia tridentata vaseyana
ARTRW	Wyoming sagebrush	Artemisia tridentata wyomingensis
ATSP	Spiny hopsage	Atriplex spinosa
CHNA2	Gray rabbitbrush	Chrysothamnus nauseosus
CHVI8	Green rabbitbrush	Chrysothamnus viscidiflorus
PUTR2	Antelope bitterbrush	Purshia tridentata
ROWO	Wood rose	Rosa woodsii
SYOR2	Mountain snowberry	Symphoricarpos oreophilus

BLM LIBRARY
SC-653, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047

BUREAU OF LAND MANAGEMENT
Idaho State Office
3380 Americana Terrace
Boise, Idaho 83706

BLM-ID-PT-94-006-4050